Battling bird flu by the numbers

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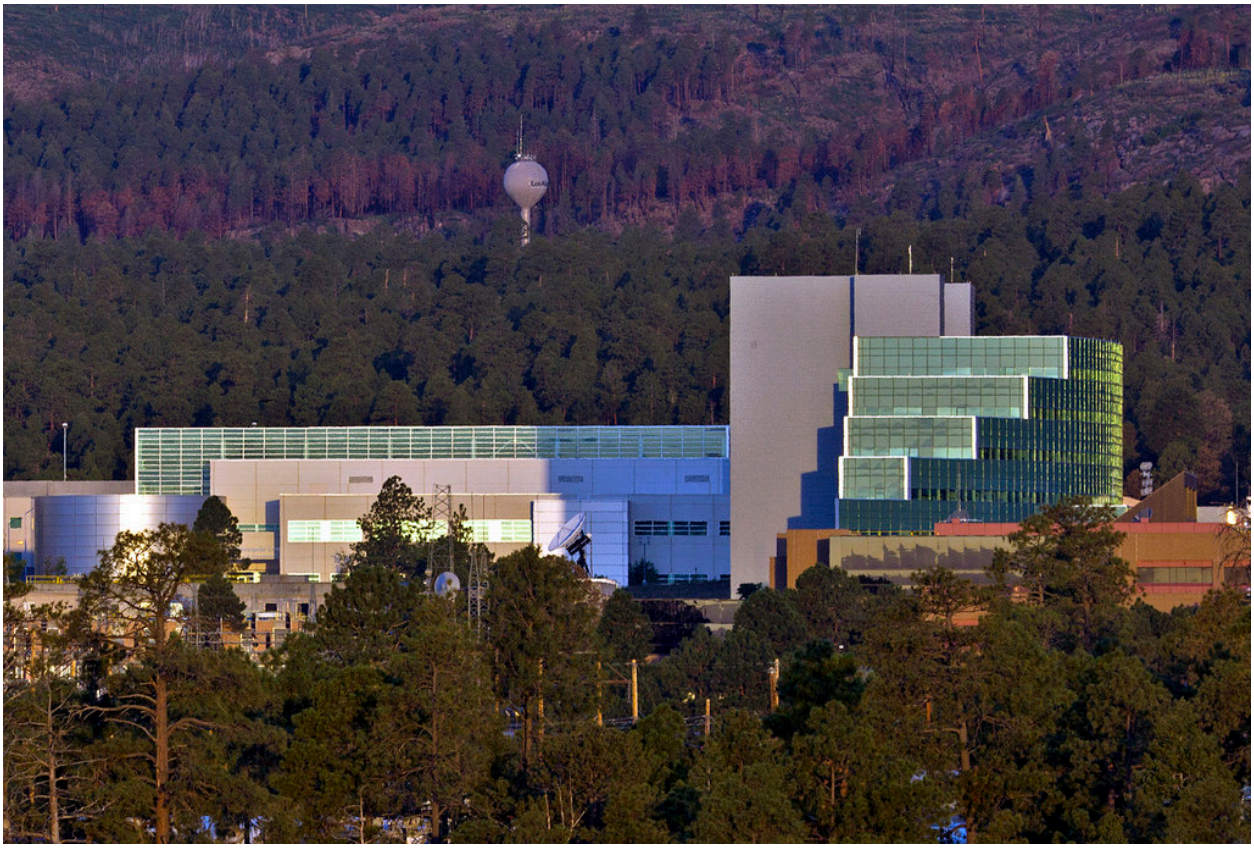

Los Alamos mathematical model gauges epidemic potential of emerging diseases

LOS ALAMOS, New Mexico, May 27, 2008—A pair of Los Alamos National Laboratory theorists have developed a mathematical tool that could help health experts and crisis managers determine in real time whether an emerging infectious disease such as avian influenza H5N1 is poised to spread globally.

In a paper published recently in the Public Library of Science, researchers Luís Bettencourt and Ruy Ribeiro of Los Alamos' Theoretical Division describe a novel approach to reading subtle changes in epidemiological data to gain insight into whether something like the H5N1 strain of avian influenza—commonly known these days as the "Bird Flu"—has gained the ability to touch off a deadly global pandemic.

"What we wanted to create was a mathematically rigorous way to account for changes in transmissibility," said Bettencourt. "We now have a tool that will tell us in the very

short term what is happening based on anomaly detection. What this method won't tell you is what's going to happen five years from now."

Bettencourt and Ribeiro began their work nearly three years ago, at a time when the world was wondering whether avian influenza H5N1, with its relatively high human mortality rate, could become a frightening new pandemic. Health experts believe that right now the virus primarily infects humans who come in contact with infected poultry.

But some health experts fear the virus could evolve to a form that would become transmissible from human to human, the basis of a pandemic like the 1918 Spanish Flu that killed an estimated 50 million people.

The Los Alamos researchers set out to create a "smart methodology" to look at changes in disease transmissibility that did not require mounds of epidemiological surveillance data for accuracy. The ability to look at small disease populations in real time could allow responders and health experts to implement quarantine policies and provide medical resources to key areas early on in an emerging pandemic and possibly stem the spread.

Bettencourt and Ribeiro developed an extension of standard epidemiological models that describes the probability of disease spread among a given population. The model then takes into account actual disease surveillance data gathered by health experts like the World Health Organization and looks for anomalies in the expected transmission rate versus the actual one. Based on this, the model provides health experts actual transmission probabilities for the disease. Unlike other statistical models that require huge amounts of data for accuracy, the Los Alamos tool works on very small populations such as a handful of infected people in a remote village.

After developing their Bayesian estimation of epidemic potential, Bettencourt went back and looked at actual epidemiological surveillance data collected during Bird Flu outbreaks in certain parts of the world. Their model accurately portrayed actual transmission scenarios, lending confidence to its methodology.

In addition to its utility in understanding the transmissibility of emerging diseases, the new method is also advantageous because it allows public health experts to study outbreaks of more common ailments such as seasonal influenza early on. This can assist medical professionals in making better estimates of potential morbidity and mortality, along with assessments of intervention strategies and resource allocations that can help a population better cope with a developing seasonal outbreak.

"We are closing the loop on science-based prediction of transmission consequences in real time," said Ribeiro. "A program of this type is something that needs to be implemented at a worldwide level to provide an integrated way to respond a priori to an emerging disease threat."